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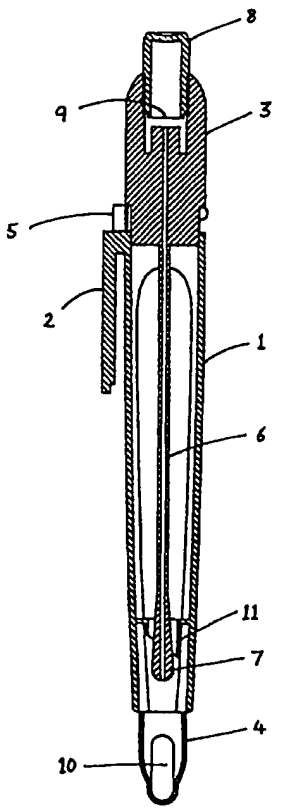
(54) Title: SAMPLE-COLLECTING AND ASSAY DEVICE

(57) Abstract

An assay device comprises a tube (1), a removable top part (3) and a bottom part (4), wherein an elongate member (6) with a swab (7) at its distal end is mounted on the top part, the top part includes a compartment (8) containing liquid and partly defined by a first frangible membrane (9) that can be ruptured to release the liquid into the tube, and the bottom part contains a reagent and is partly defined by a second frangible membrane that can be ruptured on movement of the bottom part relative to the tube. Reaction occurring in the bottom part can be observed through a window (10).



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SAMPLE-COLLECTING AND ASSAY DEVICE

Field of the Invention

This invention relates to a sample-collecting and assay device, and in particular to a simple hygiene monitor.

Background of the Invention

WO-A-9425619 describes reactions where metabolites such as ATP can be amplified and detected, e.g. colorimetrically. Application of this chemistry is of value in dirt monitoring or in the detection of microorganisms on a surface that are collected by swabbing.

WO-A-9525948 discloses a sample-collecting and assay device comprising a tube, a removable top part and a bottom part, wherein an elongate member with a swab at its distal end is mounted on the top part. There may be one or more foil-sealed bottom parts fixed within the tube, and the foils are successively broken by movement of the swab, or a coaxially-extending blade-like member, through the tube.

WO-A-9703209 discloses a similar device, in which reagent is contained in a bottom part with a window, and which has a seal broken by movement of the swab through the tube. Another similar device is disclosed in WO-A-9723596.

Summary of the Invention

An assay device according to the present invention is for use in determining the presence in a liquid sample of a target component that, in combination with other components, undergoes a reaction to give a detectable signal. The novel device comprises a tube, a removable top part and a bottom part, wherein an elongate member with a swab at its distal end is mounted on the top part, the top part includes a compartment containing liquid and partly defined by a first frangible membrane that can be ruptured to release the liquid into the tube, and the bottom part contains a reagent and is partly defined by a second frangible membrane that can be ruptured on movement of the bottom part relative to the tube.

By means of the invention, direct analysis can be made, by observing the signal generated, in the bottom part. Although the novel device shares many characteristics with the prior art devices, described above, its particular advantages include the use of a syringe-like mechanism within the top dispenser, to ensure repeatable and reproducible dispensing of liquid reagent. Although the top part may be unitary or comprise a

separate component containing reagent, the design of the top reagent container and its holder may be such that a single operation, depressing the container, ruptures the seal and evacuates the contents of the container down the swab shaft, ensuring accurate and reproducible dispensing of the liquid reagent with minimal dead volume and without introduction of any air, unlike a "pumping" dispensing system.

Description of the Invention

A device of this invention is particularly suitable for determining the presence of microorganisms, in which case the target component is ATP. The invention will now be described by way of example only with reference to this embodiment.

Further, again for the purpose of illustration, the invention will be described with reference to reactions of the type described in WO-A-9425619, i.e. involving enzymes and their substrates. These materials constitute the components that, in combination, undergo the reaction that gives the detectable signal. Such a reaction includes the following:

$$AMP + ATP \rightarrow ADP$$

$$ADP + G6P \rightarrow ATP + G$$

wherein G is glucose and G6P is glucose-6-phosphate. These reactions are catalysed by adenylate kinase and glucokinase. Glucose is then converted to give a colour, in a further enzymatic sequence, e.g. utilising glucose oxidase (GO) and horseradish peroxidase (HRP).

Alternatively, the analyte may be detected by bioluminescence. Suitable reagents etc. are described in WO-A-9525428.

The reaction components may be present together in the bottom part, in a freeze-dried mixture.

In use of a device of the invention, a sample, e.g. of microorganisms obtained by swabbing, is provided and the reagents and liquid are mixed with them. Especially if the reaction generates a colour, comparison of that and a standard can be made readily, to give a quick indication of the concentration of the analyte in the sample.

The invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1A shows separate side views of a device embodying the invention, and Figure 1B is a cross-section of the same embodiment, along the line A-A in Fig. 1A; and

Figure 2 is an exploded view of the embodiment shown in Fig. 1.

For simplicity, a device of the invention will be described with reference to Fig. 1B. The embodiment illustrated there comprises a tube 1 with a pen-type holder 2. A top part 3 and a bottom part 4 are each mounted on the tube and each can be pushed into close engagement with the tube. In the case of the top part, close engagement is prevented, until required, by the removable or peelable safety seal 5.

The top part 3 has mounted thereon a tubular elongate member 6 that terminates in a swab 7. The top part 3 also comprises a separate component 8 which is a compartment having a foil seal 9. On depression of this component, by a simple syringe action, without pumping, the foil seal is ruptured, and a known amount of liquid is discharged down the elongate member to the swab 7, within the tube 1. The top end of the elongate member is a sliding fit within the component 8.

The bottom part 4 is in the form of a foil-sealed cuvette including a window 10. It may contain freeze-dried reagent(s). The foil is broken by pushing the part 4 inwardly with respect to the tube 1. The foil may be broken on the swab or on an angled blade-like member 11 provided as an internal component of the tube 1.

In use, the top part 3 is removed from the tube 1, a sample is taken up on the swab 7, and this is replaced in the tube. The seal on the bottom part 4 is then broken. The safety seal 5 is then removed, and the component 8 pushed inwards, to release a known quantity of liquid. Results can be read through the window 10. A qualitative assessment can be made by comparison of the colour generated with reference spots of different colour intensity (of which three are shown in Fig. 1A).

Various modifications to the illustrated device may be made, within the scope of the invention. For example, the proximal end of the elongate member 6 may be longer, so that it extends to a greater extent into the component 8, when that is depressed, so that there is a smaller residual volume. That volume may be accurately predetermined, e.g. 50 μL. That in turn ensures that for a given volume of liquid in the component 8, e.g. 500 μL, a predetermined amount is accurately dispensed, *via* the elongate member, to the swab.

A further modification involves, instead of the seal 5, a frangible connection between the two pieces of the top part. This allows the whole of the top part to be used in swabbing; when replaced on the tube, breakage of the frangible connection allows

relative movement of the two pieces of the top part, to release the liquid. Preferably, the top part and the tube comprise means for their mutual location, e.g. a tongue and groove. It is also preferred that the frangible connection between the two pieces of the top part should be broken by relative rotation, i.e. in a sense different to that in which movement releases the liquid. This is also assisted by the mutual location of the top part and the tube.

When the seal on the component in the top part is broken, liquid (i.e. extractant/buffer) surrounds sample that has been collected on the swab. When the seal on the bottom part is then broken, simple shaking allows the sample to be removed from the swab as well as activating reagent in the bottom part. This assists the quantitative nature of the analysis.

CLAIMS

1. An assay device comprising a tube, a removable two-piece top part and a bottom part, wherein an elongate, tubular member having a swab at its distal end is mounted on one piece of the top part, wherein the other piece of the top part includes a compartment containing liquid and partly defined by a first frangible membrane that can be broken, by relative movement of the two pieces, to release the liquid into the tubular member, and wherein the bottom part contains a reagent and is partly defined by a second frangible membrane that can be broken on movement of the bottom part relative to the tube.

2. A device according to claim 1, wherein the bottom part comprises a window, for observation of a reaction therewithin.

3. A device according to claim 1 or claim 2, wherein the proximal end of the tubular member is a sliding fit within the compartment, on the relative movement thereof.

4. A device according to any preceding claim, wherein the two pieces of the top part are frangibly connected, whereby breakage of the connection allows said relative movement of the two pieces.

5. A device according to claim 4, wherein the frangible connection is broken by relative rotation of the two pieces.

6. A device according to any preceding claim, wherein the top part and the tube comprise respective means for their mutual location.

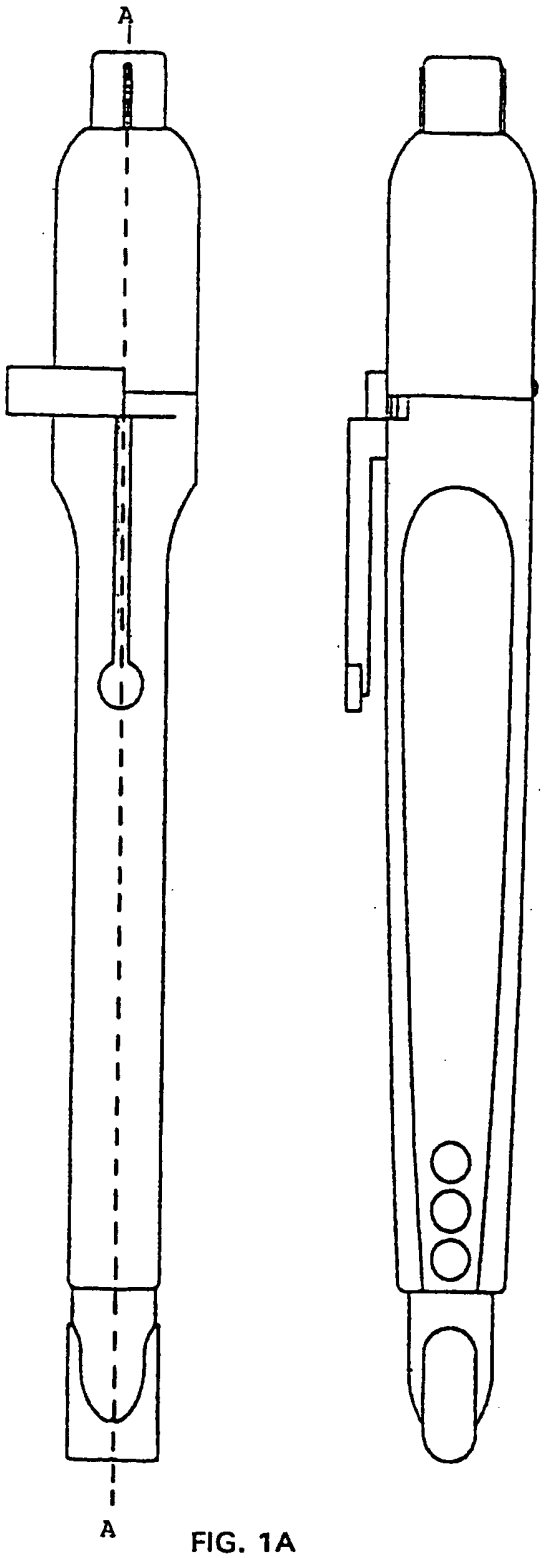

FIG. 1A

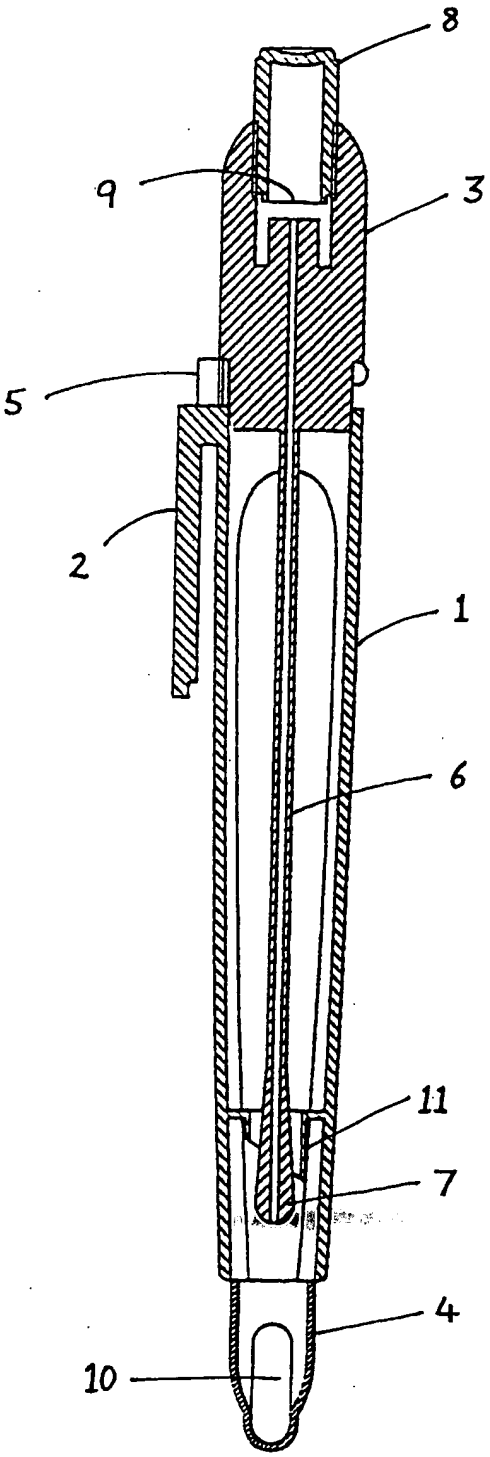

FIG. 1B

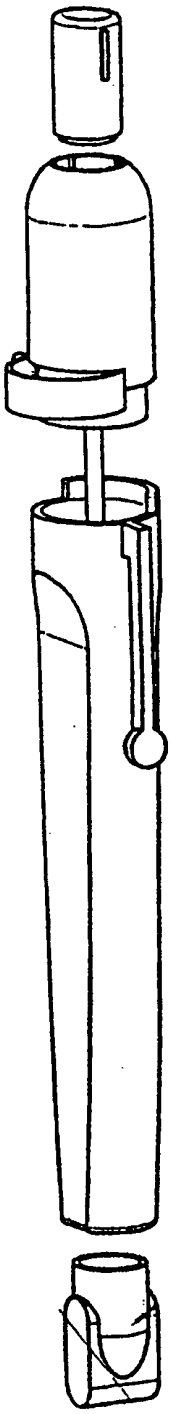

FIG. 2

INTERNATIONAL SEARCH REPORT

ational Application No
PCT/GB 98/03669

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C12M1/30 A61B10/00 B01L3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 96 14570 A (IDEXX LAB INC) 17 May 1996 see page 3, line 25 - line 26 see page 4, line 10 - line 14 see page 10, line 9 - line 29; figure 3A see page 11, line 2 - line 34; figures 5C,6	1
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
23 March 1999	31/03/1999

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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